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Energy for Water in Agriculture: A Partial Factor Productivity Analysis

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Key Points

Managing the closely interlinked water-energy-food nexus requires a holistic approach, as inefficient use of any of the three resources can have a negative effect on the other two. In countries with high rainfall, policy makers rarely need to worry about the nexus. But elsewhere, the effects are felt throughout the economy.

There is significant variance in the productivity of water for agriculture, and the energy required to extract that water, across countries. The most productive countries are typically those where the agriculture sectors rely on rainfall and surface water. Groundwater well depth, pump efficiency and the prevalence of desalination can affect the energy required to meet water demand for agriculture.

Given uncontrollable factors like water scarcity, there may be limits to how much certain countries can improve their productivity of water for agriculture. The results of our study highlight the opportunity cost for some countries of engaging in certain types of domestic food production, and suggest efficiency gains could be achieved through crop switching and/or importing water intensive crops.

Summary

Water, energy and food are inextricably linked and, consequently, inefficient use of any of the three resources can have a negative effect on the other two. Managing this nexus requires a holistic approach.

We compare the productivity of extracted water used for agriculture, and the energy required to withdraw that water, across countries. Agricultural productivity is measured from both an economic (contribution to GDP) and physical (metric tons produced) perspective. Our results offer insights into how water and energy are used by countries for agriculture production and what policies governments could consider for improving the sustainability of water resources. Specifically, our results suggest:

> There is significant variance in the economic productivity of water for agriculture, and the energy required to extract that water, in the countries we studied.

> The relationship between total water use for agriculture and the energy required to withdraw water is loosely correlated. When a lack of correlation exists it is because of differences in groundwater well depths and/or differences in rainfall available for crop production.

> Physical productivity (sometimes referred to as ‘crop per drop’) divergences are even greater than economic divergences among the countries studied, particularly for crops that consume a lot of water.

Our findings highlight the opportunity cost for some countries of engaging in certain types of domestic food production, and suggest that efficiency gains could be achieved through crop switching and importing water intensive crops.

The findings also suggest that there may be limits to how much the productivity of water can be increased in certain countries where water is extremely scarce. This gives further support for the potential benefits of virtual water trade. Our results suggest that productivity improvements are more easily achieved by emerging countries which have higher rainfall.

This paper represents a first attempt at understanding the productivity of water and energy for agriculture across countries. The availability of more granular data on pump efficiencies, groundwater depths and water extraction would make the results more conclusive. Moving forward, countries must improve their data on how water is extracted for agriculture, as this will better determine the opportunity costs involved in growing certain crops domestically.

Introduction

Water, energy and food are inextricably linked. Large quantities of water are used to produce hydroelectricity, cool power plants and refine petroleum products. Similarly, energy is a critical input for the extraction, treatment and transportation of water. Food relies heavily on both energy and water: an increase in the price of either can have an inflationary effect on food prices, while increases in agriculture production can strain water and energy resources. Because of the interconnectedness of water, energy and food, inefficient use in one sector can have a negative effect on the other two.

There has been in-depth analysis on how water contributes to agricultural productivity. In 2003, Molden et al. suggested a framework for exploring the relationship between water and agricultural value added, using a partial factor productivity analysis – effectively looking at the value added of agriculture obtained from extracted water use, holding all other factors of production constant. This concept has been applied to numerous case studies, as summarized by Zwart and Bastiaanssen (2004). Their work assessed water productivity values for irrigated wheat, rice, cotton and maize in a variety of regions, based on a review of 84 literature sources.

By contrast, research on the water-energy-food nexus is still in its infancy. Recent studies have sought to describe this inter-relationship (Hellegers, P.J.G.J. et al. 2008; Bazilian et al. 2011; World Economic Forum 2011; Adnan, 2013) or offer broad policy recommendations on how to manage the sustainability of the components of this nexus (Bizikova, L. et al. 2013). Some detailed, quantitative studies on the nexus exist, but they are generally limited to specific regions such as Southern Spain, the Hindu Kush or the Aral Sea Basin (Soto-García et al. 2013; Rasul, 2014; Granit et al., 2012).

Building on Molden's framework, we compare the productivity of extracted water use for agriculture, and the energy required to withdraw that water, across countries. Our results offer insights into how water and energy are used by countries for agriculture production, and what policies governments could consider for improving the sustainability of their water resources.

We define water productivity as the return on extracted water used in production, while energy-water productivity refers to the return on the energy used to extract and treat water. Return is calculated in two ways: physical and economic. Physical productivity assesses 'crop per drop' and 'crop per kilowatt hour', or the physical yield in the agricultural sector per unit of water or energy used. By contrast, economic productivity determines the 'GDP per drop' and 'GDP per kWh' in countries.

Understanding the energy component of water extracted is important for two reasons. First, supply constraints on energy can be a limiting factor for growth, particularly in the developing world. Countries that use significant energy resources for agriculture will have less energy available for other sectors of the economy. Second, countries that use water productively for agriculture may still require significant energy resources to extract that water, which could pose a question as to the efficacy of irrigation for agriculture. Incorporating an energy dimension into water productivity offers a unique perspective on the total burden water withdrawals place on the economies and natural resources of countries. In addition, understanding how energy use relates to water withdrawals for agriculture is of particular importance given that the agriculture sector consumes roughly 70 percent of water withdrawn globally (UN Food and Agriculture Organization, FAO Aquastat, 2014).

This paper is organized as follows:

Section 1 describes the theoretical rationale (and limitations) for engaging in a partial factor productivity analysis for water and energy in agriculture. Section 2 explains the methodology for how water and energy use is estimated in countries. Section 3 describes the results of the partial factor productivity analysis for the sample of countries.

It should be noted that our intention was to make the countries analyzed inclusive, representing both rich and poor, water scarce and water abundant, and those with varying water and energy prices. However, the sample of countries was determined in part by data availability. Despite this limitation, our final sample of 41 countries offers a broad examination of diverse countries. Section 4 offers our conclusions and policy recommendations.

Calculating Water and Energy-water Productivity in Agriculture

Productivity is a measure of output per unit of input. In the aggregate, it represents the output reached from a combination of factors of production. To maximize productivity, there is a need to be both technically and allocatively efficient. Technical efficiency is achieved when producers create maximum output given a set of inputs, while allocative efficiency refers to combining the mix of production factors in such a way that economic returns are maximized.

While calculating productivity demonstrates the limits of production that can be achieved from a set of inputs, decomposing the production function can be used to explain the relative importance of each factor of production to output. A single component's contribution to output is its partial factor productivity. For example, the partial factor productivity of water (or energy-water) in agriculture is the agricultural output per unit of water (or energy-water) input. As previously noted, this can be calculated from an economic (GDP per input) or physical (crop per input) perspective. In essence, the productivity of a single factor offers the production possibilities for that factor given a certain technical efficiency, and holding all other factors of production constant.

Although calculating partial factor productivity is a useful exercise, it is incomplete. This is because factors of production are substitutes and improving the productivity of one factor can lead to productivity reductions in another factor. For example, improving water productivity (i.e. reducing water use per unit of agriculture output) may require large expenditures in costly drip irrigation technologies. When this is the case, an improvement in water productivity may come at the expense of capital productivity and perhaps overall costs of production (i.e. total factor productivity).

For a farmer, the decision to invest in drip irrigation can be represented as a function of the cost of the irrigation system and the cost savings from using less water and energy. If the irrigation system is more expensive to install and run than the cost savings delivered, the investment will not make economic sense. Similarly, in cases where energy prices are low, it may make economic sense to avoid investing in energy saving technologies like efficient water pumps, as the cost savings from using less energy are not justified because of the higher purchase costs of the efficient pumps. The implications of substitution on total costs of production are the reason producers allocate resources based on total factor productivity, even if this means some factors of production are used less efficiently.

Despite being incomplete for rationalizing decision making, calculating partial factor productivity of both water and energy for agriculture production is important for two reasons:

> First, the prices of each input often do not reflect their opportunity costs or scarcity. As a result, they are overused in production and not always allocated to where the marginal benefit to society is the highest. For example, while using low cost water and energy excessively in production might maximize profitability for a farmer, the societal implications of this strategy could be negative if doing so were to result in scarce water and energy resources being diverted from more productive uses.

> Second, water is best described as a common pool resource, meaning it is non-excludable but rivalrous. The lack of clear and/or enforceable property rights over common pool resources can result in their often being overexploited and depleted at the expense of future generations (Olstrom, 1990). Understanding whether or not water and energy are being productively used in agriculture is the first step in long-term management of these resources. This assessment is best achieved by a cross-country examination.

In effect, discussions on water and energy-water productivity for agriculture are not unlike the debates on the productivity of land for agriculture that occurred after the Second World War (Brown, 2004). At the time, a projected explosion of the globe's population prompted a discussion on how to increase agricultural production while keeping food prices competitive and ensuring land was used sustainably. The resulting policy change was a mix of innovation, price controls and heavy investment that resulted in increases in world grain productivity from 1.1 tons per hectare in 1950 to 2.9 tons in 2004 (Brown, 2004; Fisher, 2014). Following the same logic, we explore water and energy-water use in agriculture in a sample of countries with the objective of understanding how countries are using these resources, what drives allocation and where improvements can be made.

Water and Energy-water Productivity: Methodology

To calculate water and energy-water productivity for agriculture, it is necessary first to know the total amount of water used in agriculture and the sources of that water. Compiling data from the FAO Aquastat Database, country national accounts, the Desal Database produced by consultants Global Water Intelligence, and academic literature, we estimate extracted water use for all agriculture in a sample of countries (see Figure 1 for a sample of countries and all sources). Data are based on the latest year available.

While data exists for water withdrawals, attributing energy values to these withdrawals is a more complicated task. To do this, the different sources of water for agriculture (i.e. surface water, groundwater, advanced treated/desalinated water) and the physical energy costs of extraction and treatment in each country must be estimated. For example, a country that obtains a majority of its water for agriculture from the surface will use far less energy per cubic meter of water withdrawn than a country that obtains water from deep aquifers or desalinated water. Similarly, the hydraulic characteristics (e.g. efficiency, friction losses, drop point pressure of pumps used for extraction, or the type of desalination technology used (membrane compared with thermal) may affect energy use.

To estimate energy used for water extraction, we divide water into conventional and unconventional sources. Conventional water refers to groundwater and surface water, both of which are untreated and sent directly from the source to the user. Unconventional water refers to seawater, brackish water and brine, all of which must be purified by water treatment technologies before consumption. It should be noted that we omitted energy for wastewater treatment and water transport, despite their importance from the analysis, for two reasons. First, energy data for both are scarce. Second, neither wastewater nor large water transfers are used for agriculture on a large scale at the country level. Thus while, as a result, our findings may underestimate energy use, they incorporate the most significant sources of water for agriculture.

The energy required to extract conventional groundwater is a function of three components: the depths of the groundwater bores, the efficiencies of pumps used for extraction, and flow rates. The term flow rates denotes the amount of water extracted from individual bores per unit of time. The relationship between these variables for calculating energy used for withdrawals is seen in the following equation, as described by Nelson and Robertson (2008):

$$e_W = \frac{l * d}{\varepsilon}$$

where energy required for extraction e_W is a function of the lift parameter, l (which represents the theoretical energy required to lift a volume of water vertically assuming no friction and perfect pump efficiency); the depth of the well, d; and the pump efficiency, ε.

Employing this relationship, we collect and analyze data on bore depths, pump efficiencies and flow rates for 41 countries. In each case, complete country data was not available, so energy intensity coefficients were estimated from the samples and aggregated to the national level. Pump efficiencies of 60 percent and 40 percent were then assumed for developed and developing countries respectively. In reality, it is likely that there is some variance in pump efficiency among developed and developing countries, which could alter energy use calculations. For example, Shah (2009) estimates that the efficiency of groundwater pumps in India is roughly 40 percent, while transmission and distribution losses from delivering power to pump sets can be of the order of 25 percent. By contrast, theoretical pump efficiencies in developed countries, where energy prices are higher and there is an incentive to invest in more efficient pumps, can be upwards of 85 percent (Japikse, Marscher and Furst, 1997).

Surface water sent directly to an end user was estimated to consume 0.034 kilowatt hours per cubic meter (kWh/cm) and 0.023 kWh/cm for developing and developed countries respectively. This was estimated in a manner similar to that used for groundwater. That figure was a function of a 40 percent pump efficiency for developing countries and 60 percent for developed countries, with an assumed 5-meter lift for extraction.

In the rare cases where some unconventional water is used for agriculture, as in Spain, Jordan, Bahrain, the United Arab Emirates (UAE) and Saudi Arabia, the energy required for withdrawals is a function of three factors: the type of water withdrawn, the quantity of water withdrawn and the desalination technology used. In terms of desalination technology two primary types exist: thermal and membrane. The energy required for thermal desalination processes such as multi-stage flash distillation (MSF) and multiple effect distillation (MED) is higher, and is generally independent of the water salinity. By contrast, the energy required for membrane technology, such as reverse osmosis (RO) and electrodialysis (ED), is generally less, and depends on the salinity of water.

In addition to the specific technology used, other factors will affect the energy required for desalination, including the output capacity of the plant, thermal design, membrane type (for membrane technologies), the efficiency of the plant and system configuration. The latter is important to consider for dual-purpose plants (i.e. plants designed for power and water production). Since the study seeks only to calculate the energy required for water withdrawals, the energy inputs for cogeneration plants are decoupled, such that only the energy used for desalinating water is included when establishing physical energy intensity. Drawing on multiple databases and academic work, our study considered all of the factors above to estimate physical energy intensities (kWh/cm) for desalination plants in the sample countries.

Results and Analysis

Figure 1 shows results for 15 representative countries, while the results for all 41 countries are included in the Appendix. These lead us to two observations:

First, there is significant variance in both the water and energy-water productivity in the sample of countries. For example, the most water productive country in Figure 1 is Canada, with a ratio of 2.19. This means that for every one cubic meter of extracted water used for agriculture in Canada the total value added to agriculture production is equal to $2.19. (Money in this paper is stated in constant 2005 $ U.S.). By contrast, the least water productive country in the sample is Qatar, with 0.23, meaning for each cubic meter of extracted water used in agriculture the contribution to GDP is only $0.23. Canada's energy-water productivity, which measures the total value added for every kilowatt hour of energy used to extract water for agriculture, is 47 compared with 0.50 for Qatar, which is also the least energy-water productive country in the sample. Given these differences, for Qatar to achieve the same GDP return as Canada from its agriculture, it must use 9.5 times the water and 94 times the energy to extract it. This should not be seen as a criticism so much as an acceptance that arid climates benefit less from rainfall and so a greater proportion of the water for their crops must come from extracted water. This inevitably leads to lower energy-water productivity.

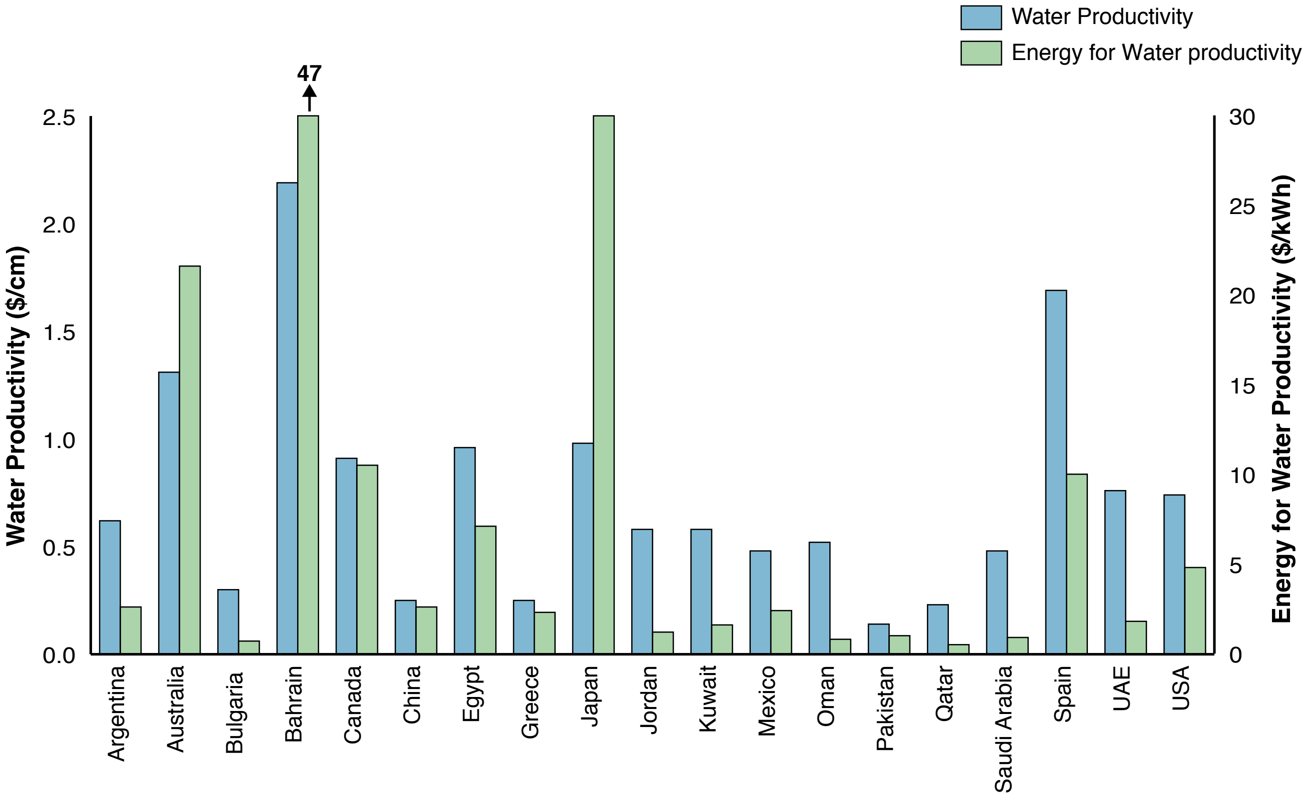

Figure 1. Value derived from unit of extracted water (and energy) in agriculture

Source: KAPSARC analysis

Second, the figure shows there is a loose correlation between water use and energy used for withdrawals. That is to say, while the relationship between water productivity and energy-water productivity is similar across most of the sample, some countries with similar levels of water productivity may have differing levels of energy-water productivity (and vice versa). For example, the United States and UAE share roughly the same water productivity at 0.74 and 0.76 respectively. Despite similar uses in water per unit of agricultural value added, the UAE uses more than double the energy to obtain that water. Canadian productivity measures are higher than the U.S. because its agriculture is predominantly limited to regions that rely on rainfall alone for growing crops.

There are two limitations to calculating water and energy-water productivity from the perspective of total value added. First, agriculture production and prices are heterogeneous, meaning there is a large variance in the types of crops produced, and their prices, across the countries sampled. Countries that produce high value added crops, or operate in markets where prices are higher, may appear to be more productive, despite the fact that their aggregate production in terms of metric tons may be less. This point is of particular significance since developing economies as these may not be as concerned with the market value of their production as with the total quantity produced, since their focus is to feed a large population. Second, many countries buy agricultural products at guaranteed prices through a federally administered body. As a result, total value added calculations can sometimes be inflated by these practices. Given these limitations, it is useful to complement the economic productivity calculation with an analysis of physical productivity by measuring the metric tons (mt) of a crop produced per unit of water or energy used.

The comparison of physical productivity, shown in Figure 2, shows an even greater divergence in productivity among countries. For example, wheat is produced by every country in the sample, with the exception of Bahrain. The differences in productivity measured by crop per drop are extraordinary among the countries in the sample. Canada and Japan produce 199 and 204 mt of wheat respectively for each 1,000 cm of water extracted and used. By contrast, Australia produces roughly 57 mt of wheat per 1,000 cm of water used. And the three least productive countries, Oman, Saudi Arabia and Kuwait, produce only 0.52, 0.45, and 0.41 mt of wheat per 1,000 cm of extracted water used to produce it. It appears that it does not make economic sense to grow wheat in regions without rainfall because the value of the crop is low compared to the cost of the water that must be extracted in terms of energy and, in some cases, the financial cost of that energy.

In terms of energy, Canada produces 4,295 mt of wheat per megawatt hour (MWh) of energy used for the extraction of water, while Japan produces 6,455 mt/MWh of wheat. The least productive nation from an energy perspective, Oman, produces only 0.79 mt/MWh hour of energy used for the extraction of water.

The primary factor that differentiates water productivity is rainfall. For Canada and Japan, only 0.4 percent of the water used to grow wheat comes from extracted surface or ground water. The remainder of the water needed for production comes from rainfall. By contrast, in Saudi Arabia, Qatar and Kuwait, 90 percent, 71 percent and 71 percent, respectively, of the water used to grow wheat comes from extracted water (Water Footprint, 2014). These large differences significantly affect the productivity levels of extracted water in the sample countries. In fact, when examining physical productivity in terms of total water used in production (i.e. the sum of extracted water and rainfall), the productivity of

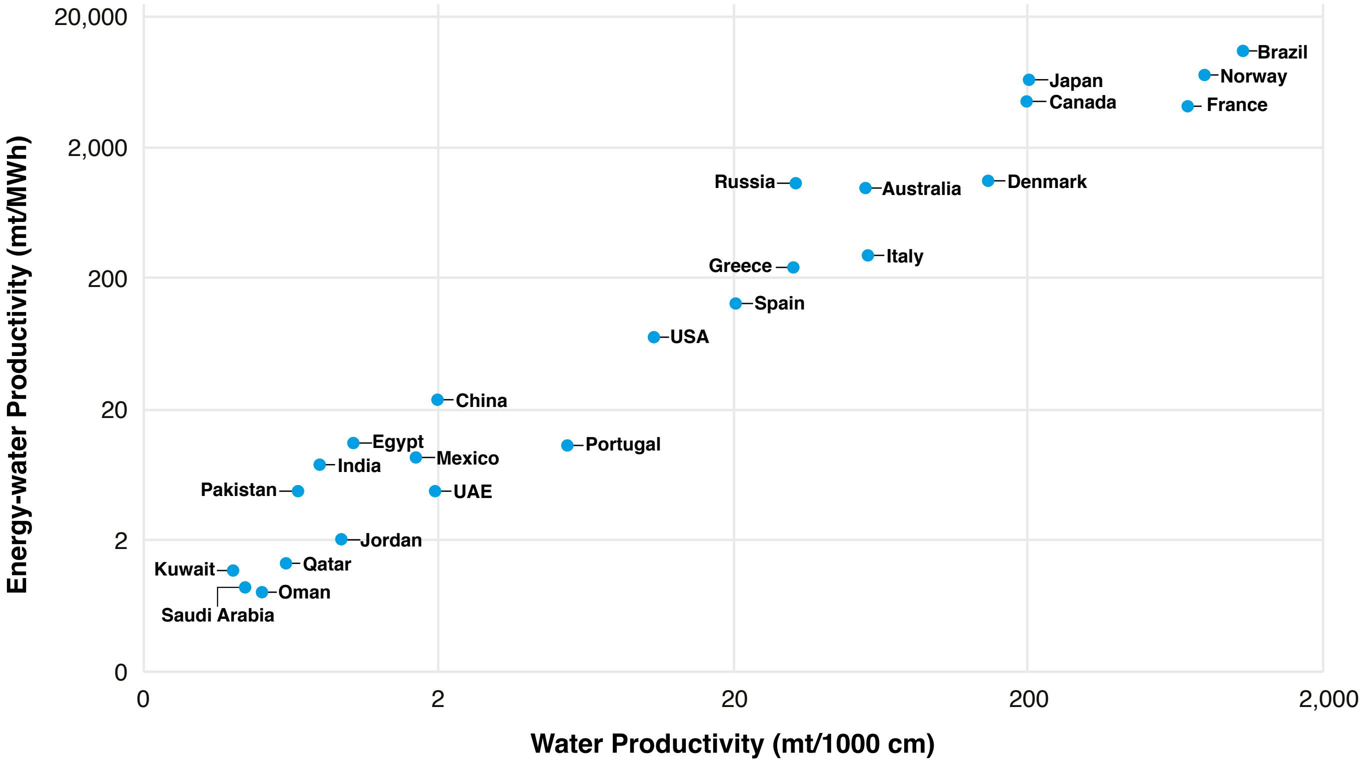

Figure 2. Metric tons (mt) of wheat derived from unit of extracted water and energy

Source: KAPSARC analysis

Saudi Arabia becomes 0.4 mt per 1,000 cm of water used, which is much closer to Canada (0.75 mt), and the USA (0.5 mt).

Similar relationships between physical production and extracted water are found in other agricultural production sectors including beef, chicken, potatoes, tomatoes, onions, and maize. In all cases, countries with crops benefiting from higher rainfall enjoy higher productivity levels from water extracted; and when rainwater is added to total water used in production the productivity levels in all countries become much more homogeneous.

In addition to the total amount of extracted water required, there are two principal reasons for differences in energy-water productivity: whether the water extracted comes from the ground or surface; and the depths of groundwater bores. First, as noted earlier, while both the U.S. and UAE have similar water productivity levels, 60 percent of the water withdrawn for agriculture use in the U.S. comes from the surface, while only 7 percent of the water withdrawn for agriculture in the UAE comes from the surface. This difference contributes, in part, to the UAE having a lower energy-water productivity. Second, in terms of depths, while Mexico and Turkey obtain similar amounts of water for agriculture from the ground (35 percent and 27 percent respectively), the average depth of wells in Mexico is 74 meters (m) compared with 38 m in Turkey. This contributes to a lower energy-water productivity in Mexico.

While for wheat there was a large diversity in physical productivity across our sample, for other crops such as potatoes, the results are more harmonized among countries (see Figure 3). Compared with wheat, the productivity of water and energy for potatoes in many Gulf countries improves; while the water and energy productivity of India and China improve dramatically. In addition, there is a reduction of productivity in countries like Australia, Spain and Greece. The primary reason for the greater convergence is that potatoes require far less water than wheat. The global average water requirement to grow wheat and potatoes is 1,619 cm/mt and 224 cm/mt respectively (Mekonnen and Hoekstra, 2011). This lower water requirement reduces the water and energy disparities between countries. The lower water requirement is a function of the different plant growing times: a potato plant's lifespan ranges from 80 to 150 days from planting to maturity, while wheat requires roughly five months from the time it is planted until it can be harvested (GeoChemBio.com, 2014a; GeoChemBio.com, 2014b).

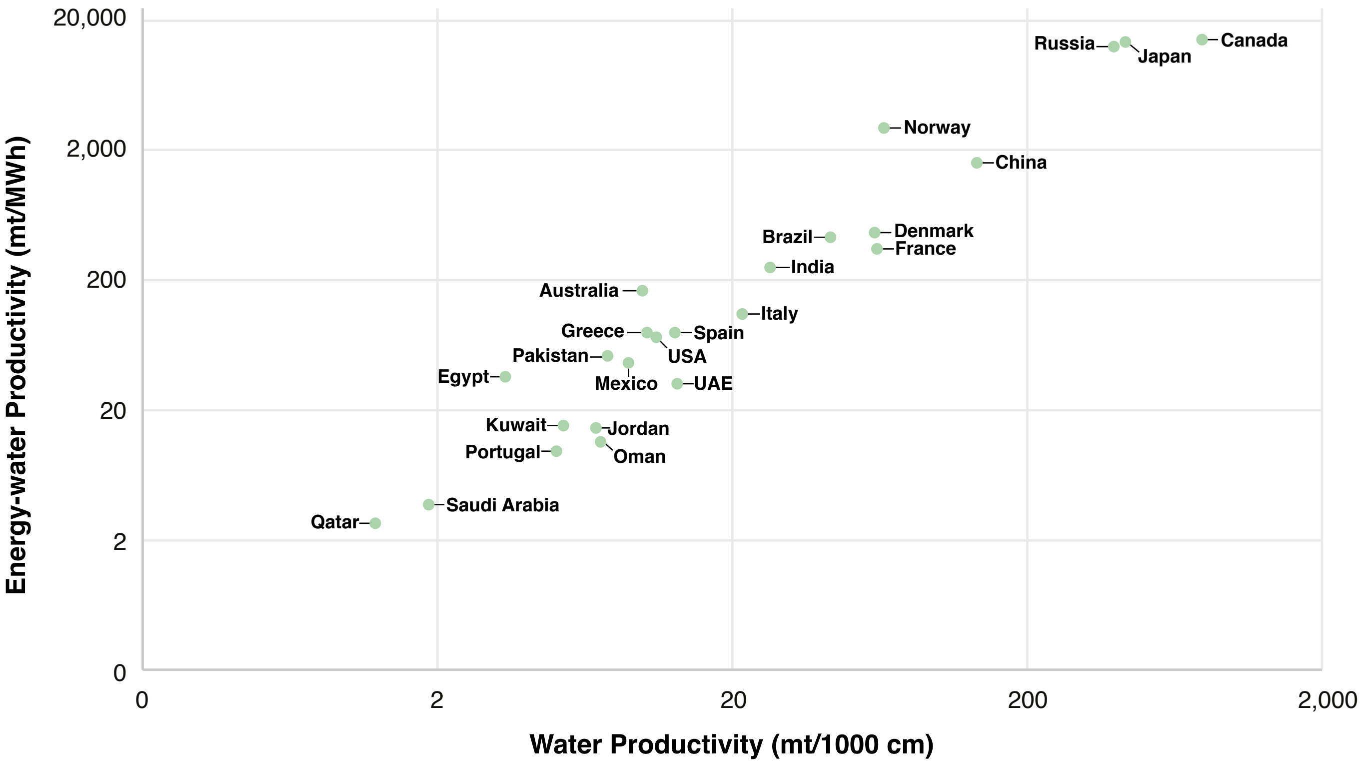

Figure 3. Metric tons (mt) of potatoes derived from unit of extracted water (and energy)

Source: KAPSARC analysis

Reliance on rain to support production of beef and chicken is much less variable, with each country relying more on rainfall and less on extracted water. For example, the country that relies most heavily on extracted water for chicken production is Bahrain, but the ratio of extracted water to rainfall is still only 27 percent. Despite this, from an absolute perspective, Bahrain's use of extracted water is still extremely high. The country uses 941 cm per metric ton of chicken produced. This means Bahrain is using 1.9 times as much water per metric ton of chicken as Saudi Arabia and over 26 times as much water as Denmark, which is the most efficient chicken producer from a water perspective (own calculations, data from Mekonnen and Hoekstra, 2012).

When translated to energy, given that Bahrain's water for agriculture comes primarily from deep underground aquifers, its energy-water productivity for chicken is only 2.58 mt/MWh used. This is higher than the figure for both Qatar (1.74 mt/MWh) and the United Arab Emirates (2.47 mt/MWh), but it is much lower than countries that rely more on rainfall and extracted surface water such as Norway (1,115.92 mt/MWh) and Canada (414.45 mt/MWh).

Conclusions and Policy Implications

This paper offers insights into the productivity of water, and the energy required to withdraw that water, across a sample of countries. Our analysis shows that there is a wide divergence in both the energy and water productivity in our sample of countries, and indicates that countries with the highest levels of water and energy-water productivity are typically those that rely on rainfall and surface water for agriculture.

From a policy perspective, the findings are particularly relevant for both countries where water is scarce (namely the Gulf region) and for emerging economies. For the Gulf region, our findings suggest that there may be a limit to how much these countries can improve water and energy-water productivity for their agriculture. It is clear that the overall water productivity for wheat in Saudi Arabia becomes much closer to that of Canada and the United States when rainfall is included. Similar ratios exist for other Gulf States when rainfall is included in the productivity calculation. This suggests that in fact the Gulf countries are using their extracted water for agriculture productively – but, given their lack of rainfall, they require significantly more extracted water for production. As a result, the productivity of that water, and the energy required for extraction, is much lower. For emerging countries that enjoy higher rainfall, our results suggest that productivity improvements could more easily be achieved. This is particularly important given that, in some emerging countries, energy for water extraction can compete with energy for industrial development or the municipal sector.

The productivity ratios demonstrated here highlight the opportunity cost Gulf countries incur when engaging in certain types of domestic food production. High water use strains aquifers, likely at a cost to future generations, while high domestic energy consumption reduces the potential profits from energy exports. The stark differences in productivity between water scarce and water rich countries demonstrate the efficiency gains that could be achieved through greater trade in agriculture products. Where possible, our research suggests the Gulf States could benefit from importing crops that are highly water intensive.

Finally, it is important to note that this paper represents a first attempt at understanding the water productivity and energy-water productivity for agriculture in a sample of countries. The precision of the results is limited by the availability of the data. More detailed data on pump efficiencies, groundwater depths and water extraction would make the results more robust. Moving forward, if countries improve their data on how water is extracted for agriculture, they will be better able to determine the opportunity costs of growing certain crops domestically.

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About the Project

The project's objective is to understand how and why the energy required to meet water demand differs between countries. To explore this question, energy used for the extraction, treatment, and transport of water is decomposed. The decomposition offers an empirical base through which to examine how energy is used in the water cycle in countries.

Building on this empirical base, the project explores the controllable and less controllable factors that lead to differences in energy use for water provision. Particular consideration is given to the effects of industrial structure, pollution, water scarcity and pricing strategies on energy and water use.

In line with KAPSARC's overall objectives, the project seeks to provide insights into how current policies influence the energy used for water withdrawals, and where improvements might be made. By exploring case studies from around the globe, the project highlights how successful practices in water and energy management from one country might be transferred to others.

The workshop series provides a space for dialogue on key issues, feedback on KAPSARC's study program, and options for future research.

Appendix

Country	Water productivity (total Agriculture, $/cm)	Energy-water Productivity (total Agriculture, $/kWh)
Argentina	0.62	2.6
Australia	1.31	21.6
Bahrain	0.30	0.7
Belgium	77.28	2158.0
Brazil	1.16	11.4
Canada	2.19	47.3
China	0.91	10.5
DR Congo	34.32	1170.8
Denmark	10.09	73.9
Egypt	0.25	2.6
Ethiopia	0.90	7.4
France	9.51	53.1
Germany	65.69	454.3
Greece	0.96	7.1
India	0.25	2.3
Indonesia	0.43	12.5
Italy	2.73	13.9
Japan	0.98	30.9
Jordan	0.58	1.2
Kenya	2.37	64.8
Kuwait	0.58	1.6
Mexico	0.48	2.4
Mozambique	2.98	44.0
Netherlands	49.47	411.7
Norway	5.08	223.4
Oman	0.52	0.8
Pakistan	0.14	1.0
Portugal	0.76	1.4
Qatar	0.23	0.5
Russia	2.44	76.4
Saudi Arabia	0.48	0.9
South Africa	0.98	2.9
Spain	1.69	10.0
Tanzania	1.11	26.8
Thailand	0.40	11.4
Turkey	1.59	16.9
UAE	0.76	1.8
Uganda	4.70	66.7
UK	9.16	137.4
USA	0.74	4.8
Uzbekistan	0.08	0.9

Notes

Notes

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